PATENT SPECIFICATION (11) 1242421

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DRAWINGS ATTACHED

(21) Application No. 41269/68 (22) Filed 29 Aug. 1968

(31) Convention Application No. 13056 (32) Filed 18 Sept. 1967 in

(33) Switzerland (CH)

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(51) International Classification H 02 k 3/04

(52) Index at acceptance

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B3E 3A 3K

(54) ELECTRICAL MACHINE CYLINDRICAL COIL WINDING

(71) We, INTERELECTRIC SACHSELN A.G. of 6072 Sachseln OW, Switzerland; a Swiss body corporate do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns an electrical machine cylindrical coil winding, and more particularly the coil of a small direct current motor or direct current generator.

Such a cylindrical coil is used when the lowest possible inertia of a rotor is desired. In addition, the cylindrical coil makes it possible to avoid the use of winding slots and thus to achieve unusually high degrees of efficiency with small direct current machines. The production of such cylindrical coils is already known, according to which an armature winding consisting of a single wire is wound in two or more layers, sweeping over one pole division in its axial reciprocating motion, extending to-and-fro in zig-zag formation in a conventional circuit and, after each turn of the wire, locating each turn close to the next the turns increasing in outer diameter with each layer. The winding direction is changed only at the axial end of the armature body and the winding is connected at its beginning and end and at various tapping points to a current supply. This type of manufacture has the disadvantage that expensive machines must be used to produce the winding.

Attempts have already been made to manufacture a hexagonal winding on a hexagonal mandrel by means of an ordinary winding machine, and to dispose this winding round the cylindrical circumference of an armature. However, this winding is of greater resistance than the winding manufactured according to the first method. The object of the present invention is to provide a cylindrical coil winding which is simple to manufacture and has a comparatively low direct current resistance.

According to the present invention there is provided an electrical machine cylindrical coil winding wherein conductor wire forming the cylindrical coil is first wound in the form of rhomboid shaped turns upon a four-sided quasi-prism with the turns displaced by at least one conductor diameter from one another, whereafter it is flattened, curved to form a cylinder, and the ends joined together to form the complete coil winding.

According to one embodiment, the conductor wire is varnished or enamelled to simplify manufacture of the cylindrical coil. The turns may be connected together by an adhesive.

According to a feature of the invention, the cylindrical coil is reinforced by a band.

Also according to the invention the cylindrical coil winding constructed as above is formed by a method comprising the steps of winding a single layer coil turn by turn on a quadrilateral quasi-prismatic support the cross-section of which corresponds to the shape of a turn of the finished cylindrical coil, the turns being rhomboid shaped, and adjacent turns of the single layer coil being displaced by at least one conductor diameter in the plane of the turn, compressing the coil at right angles to the plane of displacement to form a band coil, curving the band coil into a closed cylinder, and then fixing the coil in this position.

If desired the method may comprise the steps of winding the wire to form rhomboid shaped turns on a four-sided quasi-prismatic coil, internally supporting the prismatic coil yieldingly on two opposed edges in the connecting direction of the edges, displacing the other two edges of the prismatic coil relatively to each other in an anti-parallel direction by a desired amount, compressing the resultant structure to form a flat band coil, bending the band coil to form a closed cylinder, and fixing the coil in this position.

The invention will be described in greater detail hereinafter with reference to an em-

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bodiment illustrated in the accompanying drawings in which :—

Fig. 1 shows a flat band coil.

Fig. 2 is a side view of the band coil according to Fig. 1.

Fig. 2A is a centre longitudinal section of the band coil according to Fig. 1.

Fig. 3 is a side view of the band coil according to Fig. 1, formed into a cylinder.

Fig. 4 is a perspective view of the finished cylindrical coil, and

Fig. 5 shows schematically the essential parts of an apparatus for manufacturing a flat band coil.

An armature winding with rhomboid turns is made in such manner that a quasi-cylindrical winding is first produced on a four-sided quasi-prism and, after stripping from the prism, is pressed flat into the shape shown in Fig. 2 and then bent to form a cylinder and fixed in this position. The fixing may be achieved by baking the coils after impregnation with a thermosetting resin. The flattening of the turns to form a band coil is effected in that the individual turns of the quasi-cylindrical coil are first displaced relative to each other by the thickness of the wire used, and then the whole is compressed at right angles to the direction of displacement—if desired, with a certain twisting effect.

Fig. 1 is a view of a flat band coil produced from a wire. The production of this flat band coil is effected with the apparatus shown in Fig. 5. which has two rods 1 and 1*a* in spaced parallel relationship and two other rods 2 and 2*a* also arranged in spaced parallel relationship. The rods, 1, 1*a*, 2, 2*a* form the edges of a four sided quasi-prism and act as winding rods round which a continuous wire 3 is wound in the form of a single-layer prismatic coil. The rods 1 and 1*a* may be resiliently pre-tensioned outwardly in the direction of their connecting line, as shown by arrows. In winding the prismatic coil, any desired tappings are formed at the point of contact of the wire with the rod 1 or 1*a*. After the prismatic coil is completed with tappings 4, pressure bars 5 and 5*a* are pressed against the winding rods 2 and 2*a* respectively so that the intermediate areas of the prismatic coil are held slip-proof. Then the rods 2 and 5, on the one hand, and the rods 2*a* and 5*a* on the other hand, are moved in opposite directions towards each other and parallel to the longitudinal axis of the prismatic coil. By this means the individual turns of the coil are brought out of their helical form. The resultant coil structure is subsequently retained in this form and, after the pressure bars 5 and 5*a* are detached, it is removed from the winding rods 1, 1*a*, 2, 2*a* and pressed flat to form the band coil shown in Fig. 1. Figs. 2 and 2A are longitudinal side and sectional views respectively of the flat band coil shown in Fig. 1. The band coil is then shaped to form a cylinder as shown in Fig. 3 and in perspective in Fig. 4. In this cylindrical form the coil is then impregnated with a thermosetting resin and heated, thus forming the finished armature winding.

WHAT WE CLAIM IS:—

1. An electrical machine cylindrical coil winding wherein conductor wire forming the cylindrical coil is first wound in the form of rhomboid shaped turns upon a four-sided quasi-prism with the turns displaced by at least one conductor diameter from one another, whereafter it is flattened, curved to form a cylinder, and the ends joined together to form the complete coil winding.

2. A coil winding according to claim 1 wherein the conductor wire is varnished or enamelled.

3. A coil winding according to claim 1 or 2 wherein the turns are connected together by adhesive.

4. A coil winding according to any of the preceding claims which is reinforced by a band.

5. A method of manufacturing the cylindrical coil winding constructed according to any of claims 1 to 4, comprising the steps of winding a single layer coil turn by turn on a quadrilateral quasi-prismatic support the cross-section of which corresponds to the shape of a turn of the finished cylindrical coil, the turns being rhomboid shaped, and adjacent turns of the single layer coil being displaced by at least one conductor diameter in the plane of the turn, compressing the coil at right angles to the plane of displacement to form a band coil, curving the band coil into a closed cylinder, and then fixing the coil in this position.

6. A method according to claim 5, wherein tappings are produced in winding the single layer coil.

7. A method according to claim 6 wherein the tappings are produced along a generatline of the single layer coil.

8. A method of manufacturing the cylindrical coil winding constructed according to any of claims 1 to 4, comprising the steps of winding the wire to form rhomboid shaped turns on a four-sided quasi-prismatic coil, internally supporting the prismatic coil yieldingly on two opposed edges in the connecting direction of the edges, displacing the other two edges of the prismatic coil relatively to each other in an anti-parallel direction by a desired amount, compressing the resultant structure to form a flat band coil, bending the band coil to form a closed cylinder, and fixing the coil in this position.

9. A method according to claim 8 wherein the two opposing edges which are those nearest to each other are those which are displaced

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According to the present invention there is provided an electrical machine cylindrical coil winding wherein conductor wire forming the cylindrical coil is first wound in the form of rhomboid shaped turns upon a four-sided quasi-prism with the turns displaced by at least one conductor diameter from one another, whereafter it is flattened, curved to form a cylinder, and the ends joined together to form the complete coil winding.

According to one embodiment, the conductor wire is varnished or enamelled to simplify manufacture of the cylindrical coil. The turns may be connected together by an adhesive.

According to a feature of the invention, the cylindrical coil is reinforced by a band.

Also according to the invention the cylindrical coil winding constructed as above is formed by a method comprising the steps of winding a single layer coil turn by turn on a quadrilateral quasi-prismatic support the cross-section of which corresponds to the shape of a turn of the finished cylindrical coil, the turns being rhomboid shaped, and adjacent turns of the single layer coil being displaced by at least one conductor diameter in the plane of the turn, compressing the coil at right angles to the plane of displacement to form a band coil, curving the band coil into a closed cylinder, and then fixing the coil in this position.

If desired the method may comprise the steps of winding the wire to form rhomboid shaped turns on a four-sided quasi-prismatic coil, internally supporting the prismatic coil yieldingly on two opposed edges in the connecting direction of the edges, displacing the other two edges of the prismatic coil relatively to each other in an anti-parallel direction by a desired amount, compressing the resultant structure to form a flat band coil, bending the band coil to form a closed cylinder, and fixing the coil in this position.

The invention will be described in greater detail hereinafter with reference to an em-

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2. A coil winding according to claim 1 wherein the conductor wire is varnished or enamelled.

3. A coil winding according to claim 1 or 2 wherein the turns are connected together by adhesive.

4. A coil winding according to any of the preceding claims which is reinforced by a band.

5. A method of manufacturing the cylindrical coil winding constructed according to any of claims 1 to 4, comprising the steps of winding a single layer coil turn by turn on a quadrilateral quasi-prismatic support the cross-section of which corresponds to the shape of a turn of the finished cylindrical coil, the turns being rhomboid shaped, and adjacent turns of the single layer coil being displaced by at least one conductor diameter in the plane of the turn, compressing the coil at right angles to the plane of displacement to form a band coil, curving the band coil into a closed cylinder, and then fixing the coil in this position.

6. A method according to claim 5, wherein tappings are produced in winding the single layer coil.

7. A method according to claim 6 wherein the tappings are produced along a generatline of the single layer coil.

8. A method of manufacturing the cylindrical coil winding constructed according to any of claims 1 to 4, comprising the steps of winding the wire to form rhomboid shaped turns on a four-sided quasi-prismatic coil, internally supporting the prismatic coil yieldingly on two opposed edges in the connecting direction of the edges, displacing the other two edges of the prismatic coil relatively to each other in an anti-parallel direction by a desired amount, compressing the resultant structure to form a flat band coil, bending the band coil to form a closed cylinder, and fixing the coil in this position.

9. A method according to claim 8 wherein the two opposing edges which are those nearest to each other are those which are displaced

in an anti-parallel direction relatively to each other.

10. An electrical machine cylindrical coil winding, and a method of manufacturing said coil winding, substantially as hereinbefore described with reference to the accompanying drawings.

POTTS, KERR & O'BRIEN

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1242421 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

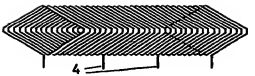

Fig. 1

Fig. 2

Fig. 2 A

Fig. 3